

REMARKS/ARGUMENTS

The present letter is filed in response to the Office Action of January 30, 2009. The Applicant also requests a one-month extension of time. Accordingly, this response is timely filed.

The Office Action dated January 30, 2009 has been carefully considered. It is believed that the claims submitted herewith and the following comments represent a complete response to the Examiner's comments and place the present application in condition for allowance. Reconsideration is respectfully requested.

Claim Status

Claims 31, 41, and 51 were previously amended. Claims 48, 49, and 53-56 were previously presented. Claims 32, 33, 35, 36, 38-40, 42-44 are in their original state. Claims 1-30, 37, 45, 47, 50, and 52 have been cancelled. Claims 34 and 46 are withdrawn.

Claim Rejections 35 USC §102

The Examiner has maintained an objection to claims 31-33, 35, 36, 38, 43, 44, 48, 49, 51, 53 and 56 under 35 U.S.C. 102(b) as being anticipated by Briones et al. (GB2120228). For the reasons that follow, the Applicant respectfully traverses the Examiner's rejection.

In rejecting claim 31 under 35 U.S.C. 102(b) as being anticipated by Briones et al, the Examiner states that Briones et al discloses "a pumpable ANFO explosive". The applicant's understanding for the Examiner's support for this position is that Briones discloses a solution in which it would be impossible to completely prevent the ammonium nitrate from crystallizing in this solution, and thus some particles will be present and will be mixed with the other components of the composition (see page 4 of the Office Action). The Applicant respectfully submits that Briones et al does not

disclose an ANFO explosive. Instead, the Applicant respectfully submits that the compositions as defined in Briones are emulsion explosives.

What is an ANFO Explosive Composition?

The Applicant respectfully submits that a person skilled in the art would know that an "ANFO explosive composition" is a term of art and comprises two basic components, namely particulate ammonium nitrate and an organic liquid fuel oil. In support of this definition, the Applicant herein encloses U.S. Patent No. 6,761,781 to Lawrence, where at column 1, lines 15-22, the inventors state:

ANFO blasting compositions are the most widely-used explosives in the world today. They are relatively simple to manufacture and are comprised of basically two commercially available components: porous prilled ammonium nitrate ("AN") and organic liquid fuel such fuel oil or diesel fuel. The AN and fuel oil are mixed generally in a stoichiometric weight ratio of 94% AN and 6% fuel oil...[emphasis added]

Briones et al does not disclose an ANFO Explosive Composition

In the Office Action, the Examiner appears to agree that ANFO explosive compositions require solid ammonium nitrate. To this end, the Examiner argued that some ammonium nitrate would crystallize using the process of Briones et al and that such crystallized particles would constitute the ANFO.

The Applicant directs the Examiner's attention to Section 2112(IV) of MPEP (chapter 21, page 47) where it states:

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic... "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." [emphasis added]

Based on the above excerpt from MPEP, it is clear that the Examiner cannot rely on the mere possibility of an event occurring in the prior art. In particular, the Applicant respectfully submits that the Examiner cannot rely on the mere possibility that crystals may form in the compositions as described in Briones to prove inherency. The Applicant submits that the Examiner has not established that the production of crystals in the compositions described in Briones is necessarily present.

On the contrary, the Applicant respectfully submits that the inventors in Briones were careful to ensure that oxidizing salts in the compositions did not crystallize. The Applicant directs the Examiner's attention to the Examples in Briones where the inventors clearly specify that the compositions are prepared in a manner to avoid the crystallization of the oxidizer salts. For example, in Example II on page 2, lines 64-65, the inventors state, "As this solution crystallizes at 70° its preparation is made above this temperature". Accordingly, the Applicant respectfully submits that there is no evidence in Briones to suggest that the ammonium nitrate particles would crystallize. As such, based on the fact that the production of crystals in the compositions described in Briones is a mere possibility, the Applicant submits that the Examiner has not proven the inherency of that result.

Even if some ammonium nitrate crystals did form, which is not admitted, that Applicant submits that an inconsequential amount of crystallization is not a sufficient basis to argue that the claims are anticipated based on inherent features of Briones.

Proper consideration must be given to every element of a claim

In rejecting the Applicant's prior argument, the Examiner stated that the features upon which the Applicant relied are not recited in the claims. The Examiner stated that limitations from the specification are not to be read into the claims. While the Applicant agrees with the Examiner, the Applicant respectfully submits that the proper consideration of an element requires a consideration of the properties of that element.

In the last response, the applicant had pointed out that an ANFO explosive is a dry flowable composition whereas the composition of Briones et al did not have these properties. ANFO explosive compositions are dry flowable compositions. That is a property of ANFO explosive compositions. To argue that the composition of Briones is not an ANFO explosive composition since it is not a dry composition is not reading a limitation into a claim. It is merely pointing out that the cited reference cannot be an ANFO explosive composition since it does not have the required properties of an ANFO explosive composition.

The Applicant directs the Examiner's attention to Section 2106 of the Manual of Patent Examination Procedure, where it states on page 8:

Finally, when evaluating the scope of the claim, every limitation in the claim must be considered. USPTO personnel may not dissect a claimed invention into discrete elements and then evaluate the elements in isolation. Instead, the claim as a whole must be considered...It is inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the analysis. [emphasis added]

Further, in Section 2131 (page 67) of MPEP, it states:

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. [emphasis added]

The claims of the present application are directed to a method for reducing oil segregation in an ANFO explosive composition, and using the ANFO explosive composition. Based on the above excerpts from MPEP, the Applicant respectfully submits that the Examiner must consider claim 31 as a whole, including the element concerning the ANFO explosive composition.

Briones et al does not inherently contain some ANFO explosive composition

The Applicant respectfully submits that the compositions as defined in Briones relate to aqueous compositions, and specifically, emulsion explosives. In particular, the

Applicant directs the Examiner's attention to page 1, lines 12-14 of Briones, where the inventors state:

Normally the liquid phases included in this composition are: an aqueous phase that contains inorganic oxidizing salts and an oil phase which contains the fuel; the aqueous phase is dispersed within the oil phase, producing an inverted type emulsion: water in oil. [emphasis added]

The aqueous phase of the compositions disclosed in Briones serves the purpose of dissolving the oxidizing salts (for example, ammonium nitrate). The Applicant directs the Examiner's attention to page 1, lines 52-53 of Briones, where the inventors state:

Relating to its manufacturing procedure it is only necessary to heat the aqueous phase up to a relatively low temperature to solve the salts. [emphasis added]

Furthermore, the Applicant submits that the aqueous portion of the compositions as disclosed in Briones constitute a very large portion of the composition as a whole. In particular, at page 2, lines 2-3, Briones states:

It is necessary to disperse a big volume of aqueous phase within a relatively small volume of oil phase, to achieve an oxygen global balance close to zero in the explosive emulsions. [emphasis added]

The Applicant further directs the Examiner's attention to Table 1 on page 4 of Briones where the Examples demonstrate at least a 2:1 ratio of water to gas oil, with Example 4 containing no gas oil but possessing comparable blasting properties compared to the other compositions.

Accordingly, the Applicant respectfully submits that water comprises an essential component of the composition as described in Briones. From the passages above, it is clear that the purpose of the water is to dissolve the oxidizing salt. Accordingly, the Applicant respectfully submits that the compositions disclosed in Briones contain a significant portion of water.

As the compositions of the present application are limited to ANFO explosive compositions, and such compositions are dry (i.e., the ammonium nitrate is not

dissolved in a liquid phase), the Applicant respectfully submits that claim 31 is not anticipated by Briones. Claims 32, 33, 35, 36, 38, 43, 44, 48, 49, 51, 53, and 56 are dependent on 31, and thus the foregoing arguments apply equally thereto. As such, Applicant respectfully submits that claims 31-33 35, 36, 38, 43, 44, 48, 49, 51, 53, and 56 are in condition for allowance.

Claim Rejections 35 USC §103

In the Office Action, the Examiner stated that claims 39-42, 54, and 55 are rejected under 35 USC 103(a) as being unpatentable over Briones in view of Richard. Claims 39-42, 54, and 55 are dependent on claim 31, and thus the arguments applied hereinabove with respect to claim 31 apply equally thereto. Accordingly, Applicant respectfully submits that claims 39-42, 54, and 55 are in condition for allowance.

Summary

In view of the forgoing arguments, Applicant respectfully submits that the claims of the present application are in condition for allowance. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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(12) **United States Patent**
Lawrence et al.

(10) **Patent No.:** US 6,761,781 B1
(45) **Date of Patent:** Jul. 13, 2004

(54) **HIGH DENSITY ANFO**

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(73) Assignee: **Dyno Nobel Inc.**, Salt Lake City, UT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 331 days.

(21) Appl. No.: 09/472,800

(22) Filed: Dec. 28, 1999

Related U.S. Application Data

(63) Continuation-in-part of application No. 08/986,150, filed on Dec. 5, 1997, now abandoned.
(51) **Int. Cl.**⁷ C06B 31/28
(52) **U.S. Cl.** 149/46
(58) **Field of Search** 149/46

References Cited**U.S. PATENT DOCUMENTS**

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Primary Examiner—Edward A. Miller

(57) ABSTRACT

The present invention relates to a high density ammonium nitrate-fuel oil ("ANFO") blasting composition comprising an organic liquid fuel and porous prilled ammonium nitrate of high bulk density, small particle size and good oil absorption capacity.

4 Claims, No Drawings

HIGH DENSITY ANFO

This application is a continuation-in-part of application Ser. No. 08/986,150, filed Dec. 5, 1997 now abandoned.

The present invention relates to a high density ammonium nitrate-fuel oil ("ANFO") blasting composition comprising an organic liquid fuel and porous prilled ammonium nitrate of high bulk density, small particle size and good oil absorption capacity. By "high density" in the previous sentence is meant a poured bulk density of from about 0.90 to about 1.05 g/cc.

BACKGROUND OF THE INVENTION

ANFO blasting compositions are the most widely-used explosives in the world today. They are relatively simple to manufacture and are comprised of basically two commercially available components: porous prilled ammonium nitrate ("AN") and organic liquid fuel such fuel oil or diesel fuel. The AN and fuel oil are mixed generally in a stoichiometric weight ratio of 94% AN and 6% fuel oil, and in fact, porous prilled AN ("PPAN") is conveniently capable of absorbing about 6% fuel oil. Although ANFO is relatively insensitive and thus safe to handle, it becomes a powerful blasting composition once it is properly initiated. Nevertheless, it has certain disadvantages in blasting applications.

One disadvantage is that ANFO is water-soluble and thus cannot be used reliably in water-containing boreholes unless it is packaged or otherwise segregated from water. Due to the size and porosity of the prills, ANFO has a relatively low bulk density of about 0.85 g/cc. This makes packaged ANFO difficult to use in water-filled boreholes because of the relative bulk densities and the tendency of the packaged ANFO to float in water. The low bulk density of ANFO also can be disadvantageous where explosives having higher energy densities are desired for particular blasting applications.

Efforts have been made to increase the density of ANFO-type blasting compositions. AN or ANFO prills have been combined with a liquid matrix such as an emulsion phase to form a "heavy ANFO." The liquid matrix complicates, however, the manufacturing of the blasting composition since a stable emulsion first must be manufactured. Other higher density materials or components have been added to ANFO in an effort to increase its density. For example, aluminum particles have been added to increase both bulk and energy density. A different approach involved the pneumatic ejection and packing of ANFO into a borehole, although this resulted in a packing density of only about 0.94 g/cc.

Another approach has been to use high density AN prills ("HDAN"), rather than low density, porous AN prills (PPAN). High density AN prills (HDAN) are commonly referred to as agricultural grade and are used primarily as fertilizer. They are manufactured by a different process than that used to make low density, porous AN prills and consequently the high density prills are considerably less porous and have insufficient oil absorption capacity for use effectively in an ANFO blasting composition.

Efforts also have been made to improve the oil absorption capacity of high density prills. U.S. Pat. No. 4,736,683 describes these efforts and itself describes a further effort comprising the addition of a high molecular weight polymer to improve fuel retention of the fuel on high density AN particles. Related U.S. Pat. Nos. 5,486,246 and 5,527,498 disclose a porous AN matrix, and a method for making the

matrix, of higher density than porous AN prills and having a "high" oil absorption capacity. The method involves adding an internal additive and an external coating to the high density prills.

The high bulk density, porous prilled AN ("HBDPPAN") of the present invention has comparable, if not superior, oil absorption capacity to standard PPAN and does not require the addition of polymers or of special additives or coatings in order to improve polymers or of special additives or coatings in order to improve oil retention properties. By "high bulk density" is meant a poured bulk density of from about 0.9 to about 1.0 g/cc.

During the manufacturing and handling of PPAN, a small percentage of "fines" are generated. These fines are small diameter particles that have a higher bulk density than PPAN and generally contain a relatively higher weight percentage of the anti-caking additives that are present in PPAN. These fines tend to destabilize an emulsion phase and thus normally are separated from the PPAN and sold for less value as AN fertilizer. It has been found in the present invention, however, that these fines actually function as HBDPPAN in ANFO. Their small particle size contributes to their high bulk density. Their porosity and thus oil absorption capacity results from their method of manufacture, which method of course is the same as the method for manufacturing PPAN, and from the increased surface area of the smaller prills. Thus another advantage of the present invention is the more beneficial use of fines.

SUMMARY OF THE INVENTION

The invention comprises a higher density ANFO blasting composition comprising an organic liquid fuel and HBDPPAN having a particle size of less than about 1.2 mm and an oil absorption capacity of greater than 5%. Preferably, the HBDPPAN comes from fines generated during the manufacturing or handling of PPAN.

DETAILED DESCRIPTION OF THE INVENTION

The process for manufacturing PPAN is well known. The prills are obtained by spraying droplets of a concentrated (about 95%) ammonium nitrate solution from the top of a prilling tower. As the droplets fall against a rising current of cooler air, they solidify into the familiar prilled form. As a result of water evaporation during the solidification process in the tower and subsequent drying of the prill in a drying train, voids are formed in the solidified prills, thereby imparting low density and oil absorption capacity. The prills then go through various anti-caking coating and screening steps.

The typical PPAN has a particle size range of about 1.4 to 3.0 mm and an oil absorption capacity of about 6%. This particle size is desirable because larger prills would tend to dry too slowly in the process and smaller-sized prills would require more anti-caking coating material because of their larger total surface area. During the manufacturing process and subsequent handling procedures, a small amount of fines are generated. (generally up to about 5% by weight). These fines heretofore have been considered undesirable and generally have been recycled or sold as fertilizer rather than used as PPAN. We now have found that these fines comprise HBDPPAN that can be effectively used to make high density ANFO. If desired, the manufacturing process could be tailored to generate a larger quantity of HBDPPAN.

A comparison of approximate particle sizes of HBDPPAN, PPAN and HDAN is shown in Table 1, and a

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comparison of densities and oil absorption capacities is shown in Table 2.

As can be seen in Table 1, the particle size range of HBDPPAN is much smaller than PPAN and common HDAN and extends into a much smaller range than even HDAN Sherritt Miniprills.

Table 2 compares the detonation results of ANFO blasting compositions made with PPAN, HBDPPAN and HDAN. Table 2 also compares the bulk densities of these compositions and the oil absorption capacities of the various prill types. Example 1 contained HBDPPAN and had superior detonation results to both Example 2 (PPAN) and Examples 3 and 4 (HDAN). The HBDPPAN in Example 1 had a considerably higher oil absorption capacity than the high density prills (HDAN) and even exceeded the capacity of the PPAN. The poured and settled bulk densities of Example 1 were significantly higher than those of Example 2 (PPAN) and were even higher than Examples 3 and 4 (HDAN). The HBDPPAN used in Example 1 were fines generated during the manufacture of the PPAN used in Example 2, and when used to make an ANFO blasting composition, they clearly were superior not only to high density AN prills but also to PPAN. Thus the HBDPPAN makes a superior high density ANFO blasting composition.

The HBDPPAN used in Example 1 contained an anti-caking additive comprising a surfactant coating carried in an oil-wax matrix. It was present in an amount of about 0.2% by weight of the prills, as compared to about 0.1% in the PPAN in Example 2. Anti-caking additives for the HBDPPAN may be selected from any of the AN prill coatings well-known in the art. Some examples are: talc; clay; stearic acid or derivatives; surfactants carried in an oil-wax matrix such as fatty amines, fatty acids, and fatty acid salts; and other surfactants such as alkylnaphthalene sulfonates. These coatings generally are used in amounts of a few tenths of a percent or less, but any of them, alone or in combination, may be present in an amount of up to several percent by weight of the HBDPPAN.

The organic liquid fuels for use in the compositions of the invention can be aliphatic, alicyclic, and/or aromatic and can be saturated and/or unsaturated, so long as they are liquid at the formulation temperature. Preferred fuels include tall oil, mineral oil, waxes, paraffin oils, toluene, xylenes, mixtures of liquid hydrocarbons generally referred to as petroleum distillates including diesel fuels, and vegetable oils such as corn oil, cotton seed oil, peanut oil, and soybean oil. Particularly preferred liquid fuels are mineral oil, No. 2 fuel oil, paraffin waxes, microcrystalline waxes, and mixtures thereof. Aliphatic and aromatic nitrocompounds and chlorinated hydrocarbons also can be used. Mixtures of any of the above can be used.

Various internal additives frequently are added to the AN solution before prilling to enhance the physical stability of PPAN. These can be either organic or inorganic in nature and are present in amounts generally of less than 1% by weight. Such additives do not materially affect the performance of HBDPPAN in this invention. Typical organic additives are alkylnaphthalene sulfonates or derivatives thereof. Typical inorganic additives are various sulfate salts, such as ammonium sulfate or aluminum sulfate, phosphate salts, borates and the like.

The oil absorption capacity for the HBDPPAN should be at least about 5% by weight of the prill or greater. The oil absorption capacity is measured by adding No. 2 fuel oil to the AN prills until the oil no longer absorbs into the prills but remains "wet" on the surface of the prills. Alternatively, the

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prills may be submersed in No. 2 fuel oil, and then the oil is allowed to drain off completely. The prill sample is reweighed to determine the weight percent of oil that absorbed into the prills.

While the present invention has been described with reference to certain illustrative examples and preferred embodiments, various modifications will be apparent to those skilled in the art and any such modifications are intended to be within the scope of the invention as set forth in the appended claims.

TABLE 1

AN Particle Sizes				
Typical Particle Size Ranges:				
	PPAN	HBDPPAN	ElDorado E2 HDAN Prills	HDAN Sherritt Miniprills
	1.4-3.0 mm	<1.2 mm	1.5-3.0 mm	0.5-1.4 mm

HBDPPAN and Sherritt Miniprill Particle Size Distribution:				
U.S. Sieve Size	Particle Size (mm)	HBDPPAN % in Fraction	Sherritt Miniprill % in Fraction	
-10 + 12	-2.00 + 1.70	0.3	0	
-12 + 14	-1.70 + 1.40	0.4	0.3	
-14 + 16	-1.40 + 1.168	0.4	21.2	
-16 + 20	-1.168 + 0.833	60.4	58.2	
-20 + 30	-0.833 + 0.589	5.6	16.8	
-30 + 40	-0.589 + 0.420	5.5	3.0	
-40 + 60	-0.420 + 0.250	6.8	0.1	
-60 + 100	-0.250 + 0.147	7.0	0	
-100	-0.147	13.7	0.3	

TABLE 2

	Example 1 HBDPPAN ANFO	Example 2 PPAN ANFO	Example 3 ElDorado E2 HDAN ANFO	Example 4 Sherritt Miniprills HDAN ANFO
Detonation Velocities at 20° C. (km/s):				
Density (g/cc):	1.0	0.85	1.0	1.0
Diameter (mm)				
100	3.6	2.1	fail	fail
75	3.0	fail	—	—
63	2.6	—	—	—
50	fail	—	—	—
Minimum Booster:				
75 mm (det/fail)	4½ g/#12	fail	fail	fail
Oil Absorption (wt. %):	11.0	6.1	1.5	2.0
Bulk Density (94% AN, 6% Fuel Oil):				
Poured (g/cc)	0.97	0.89	0.88	0.95
Settled (g/cc)	1.12	0.92	1.05	1.05

We claim:

1. An ammonium nitrate-fuel oil blasting composition having a poured bulk density of from about 0.90 to about 1.05 g/cc and consisting essentially of an organic liquid fuel selected from the group consisting of mineral oil, diesel fuels and mixtures thereof and porous prilled ammonium nitrate having a poured bulk density of from about 0.9 to

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about 1.0 g/cc, a particle size of less than about 1.2 mm and an oil-absorption capacity of greater than about 5%.

2. A blasting composition according to claim 1 wherein the ammonium nitrate contains an anticaking coating.

3. A blasting composition according to claim 1 containing an internal additive to enhance the physical stability of the prilled ammonium nitrate.

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4. A blasting composition according to claim 1 wherein the ammonium nitrate comprises small diameter, porous particles generated in small percentage during the manufacturing or handling of low density porous prilled ammonium nitrate.

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